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(54) Temperature sensing assembly

(57) A temperature sensing assembly for attachment to a body, such as, a pipe whose temperature is to be measured, comprises a sensor 2, e.g. a resistor or thermocouple, which is enclosed in a good thermally-conductive housing 12 such that, when the assembly is attached to the body, a portion of the temperature sensor, e.g. the front face, and a part 14 of the housing are exposed to the body. Thermal insulation 10 and 16 is present around the sensor 2 and housing 12. A second thermally-conductive housing, externally insulated, can extend around the insulation 16, with a part of this second housing exposed to the body. Electrically insulating material may be interposed between the sensor and body whilst a heat

conducting grease may be applied to the mating surfaces of the assembly and the body, to exclude any air pockets therebetween.

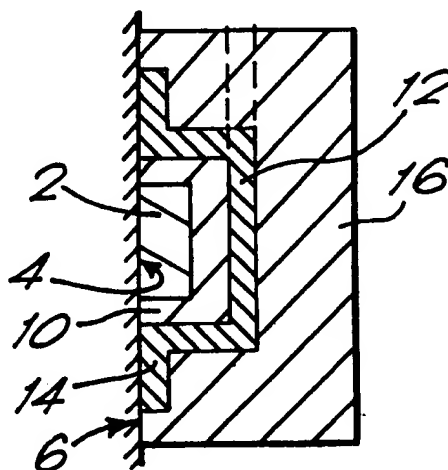
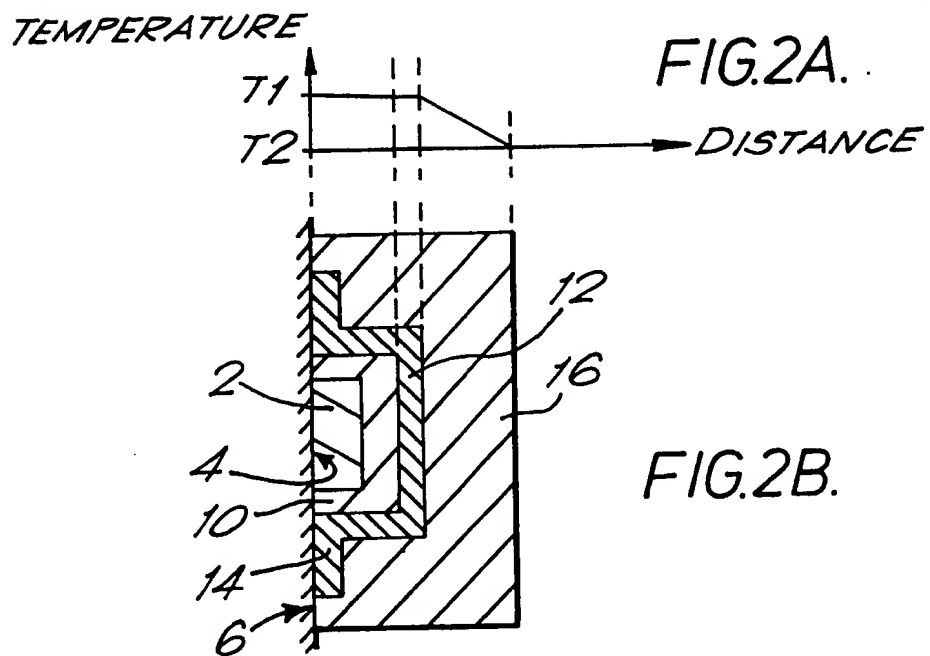
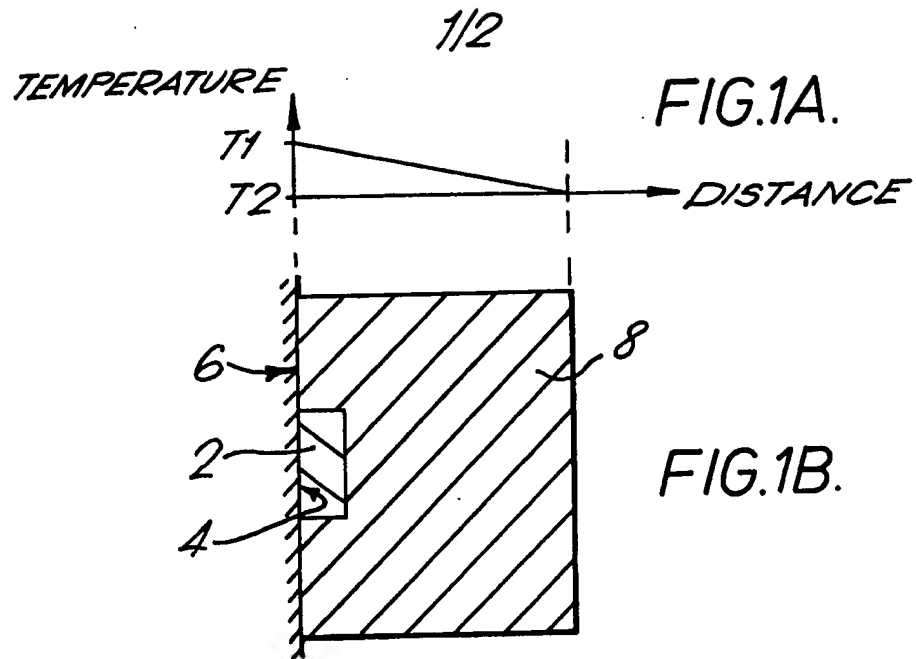


FIG. 2B.

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.



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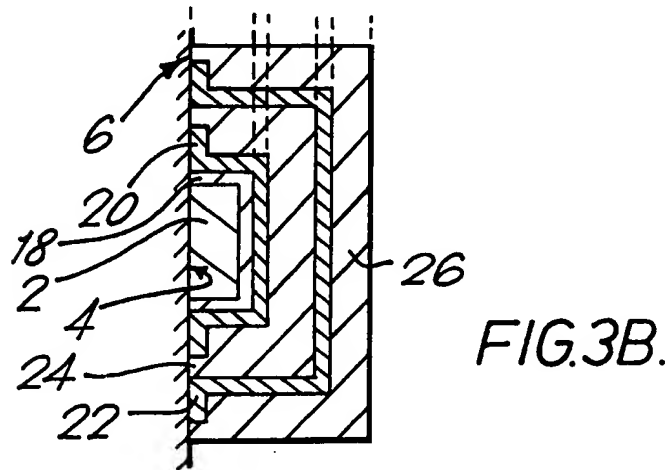
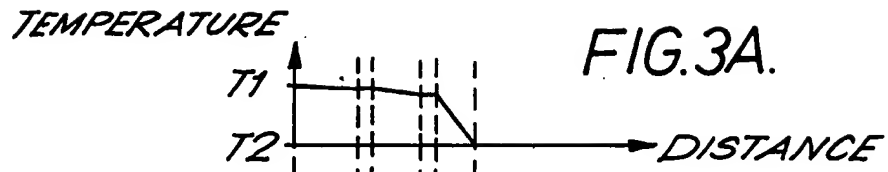
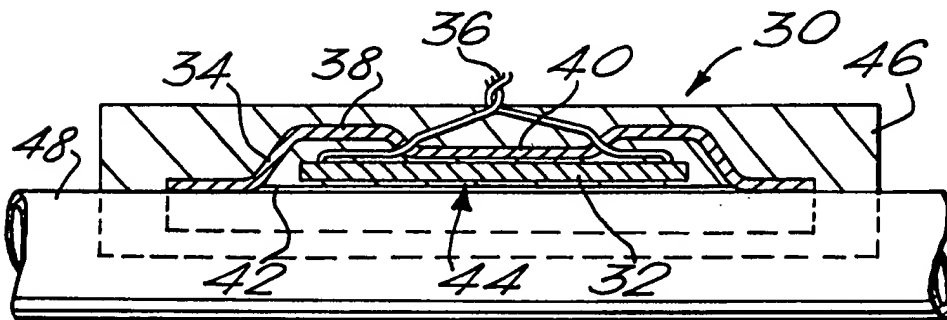


FIG.4.



SPECIFICATION

Temperature sensing assembly

5 This invention relates to a temperature sensing assembly, and its method of manufacture.

A temperature sensing assembly is used, for example, in a thermal energy meter, which may be of the type disclosed in our co-
 10 pending British Patent Application No 7842478. In the meter of that application, two temperature sensors are mounted on pipes respectively carrying hot water to and cold water from a domestic hot water system.
 15 The temperature difference measured by the two sensors is then used in deriving the amount of thermal energy delivered to the system. It is important that the sensors provide an accurate indication of the temperature
 20 of the pipes, and thus of the contents, notwithstanding the effects of different ambient temperatures and fluctuations therein.

Ideally, a temperature sensing element is immersed in, or wholly surrounded by, the material whose temperature is to be mea-
 25 sured. However, in many instances it is necessary to measure the temperature of a body by sensors attached to its outer surface. Conventionally, such sensors are covered by a thick
 30 blanket of thermally-insulating material, to reduce the heat flow to or from the surrounding air.

It is the object of the present invention to obtain better isolation from the external tem-
 35 perature, at the same time reducing the thickness of covering required.

It is a feature of a temperature sensing assembly and its method of manufacture, in accordance with the present invention, that a
 40 temperature sensor of the assembly is enclosed in a housing that is a good thermal conductor in such a way that the front of the sensor and part of the housing are exposed to the body whose temperature is to be mea-
 45 sured.

Preferably, the housing is enclosed, except at the front of the sensor, in thermally-insulating material to reduce heat loss therefrom.

A further thermally-conductive housing may
 50 extend around the enclosed insulated housing, the front of which is exposed to the body whose temperature is to be measured, thereby additionally to conduct heat from the body around the sensor to improve its temperature-measuring accuracy.

Preferably the further housing is also enclosed within a thermally-insulative material.

Preferably the or each housing is made from metal.

60 The thermal sensor may be, for example, an electrical resistance thermometer or a thermocouple.

The or each thermally-conductive housing may be shaped to conform to the outer sur-
 65 face of the body whose temperature is to be

measured, so as to provide good thermal contact between the sensor and the body.

This contact may also be physical contact, with a thin layer of electrically-insulative material being interposed if necessary, and a heat
 70 conducting grease may be applied to the mating surfaces to exclude air pockets.

With an assembly according to the present invention, heat from the body whose tempera-
 75 ture is to be measured is conducted through the or each housing to the side and back of the sensor, whereby the sensor is more completely exposed to the temperature of the body and is less exposed to the, generally
 80 different, ambient temperature and any fluctuations therein. Accordingly, a more accurate measurement is obtained of the temperature to be measured.

Temperature sensing assemblies, each in accordance with the present invention, will now be described, with reference to the accompanying schematic drawings, in which:

Figure 1A is a section through a known temperature sensing assembly;

90 Figure 1B is a graph showing the temperature distribution across the assembly of Fig. 1A;

Figures 2A and 3A are sections through a first and second embodiment respectively of
 95 the present assembly;

Figures 2B and 3B are graphs showing the temperature distribution across the assembly of Figs. 2A and 3A respectively;

Figure 4 is a more detailed section through
 100 a third embodiment of the present assembly, when mounted on a water pipe.

Referring to Figs. 1A and 1B, a temperature sensor 2 is mounted to have one face 4 thereof in contact with a surface 6 of a body
 105 whose temperature is to be measured. Away from the face 4, the sensor 2 is completely enclosed within a thick block 8 of thermally insulative material.

Fig. 1B shows the temperature across the
 110 insulating block 8 as a function of the perpendicular distance from the surface 6. It is seen that the temperature decreases linearly from a value T1 at the surface 6 to a value T2, being that of the ambient temperature, at the ex-
 115 posed outer edge of the block 8.

Referring to Fig. 2A, in the assembly in accordance with the invention, the sensor 2 is again mounted with one face 4 in good thermal contact with the surface 6 whose
 120 temperature is to be measured, and the sensor 2 is surrounded by a thin first layer 10 of thermally insulating material. A metal housing 12 extends beyond the layer 10 and along the surface 6, and entirely encloses the sensor
 125 2 and its surrounding insulating layer 10. The housing 12 has a flange 14 that extends around the sensor 2 along the surface 6 in good thermal contact therewith. A second layer 16 of thermally insulating material ex-
 130 tends completely around the housing 12.

It is seen that, as with the known assembly of Fig. 1A, the front face 4 of the sensor 2 is exposed to the surface 6. Additionally, however, the flange 14 of the conductive housing 12 is also exposed to the surface 6 and operates to conduct heat from the surface 6 around the whole of the sensor 2, so as more completely to expose the sensor 2 to the temperature of the surface 6.

Fig. 1B shows the temperature distribution across the assembly of Fig. 2A, and it can be seen that the temperature at the back of the sensor 2 is only slightly less than that of the surface 6 and thus of the temperature obtaining at the front surface 4 of the sensor 2. Since there is virtually a flat temperature distribution across the body of the sensor 2, it will more accurately represent the temperature of the surface 6 than is the case with the assembly of Fig. 1A. It is also seen from Fig. 2B that it is not until beyond the housing 12 from the surface 6 that the temperature distribution has an appreciable gradient.

Referring to Fig. 3C, the sensor 2 is again mounted with its front face 4 in good thermal contact with the surface 6. In this instance not only is the sensor mounted within a first insulating layer 18 in a conductive housing 20, but the housing 20 is itself completely contained within a second thermally conductive housing 22 and separated therefrom by a second insulating layer 24. The entire outer surface of the second housing 22 is enclosed by a third insulating layer 26.

In this second embodiment, therefore, two thermally conductive paths are provided from the surface 6 so as completely to enclose the sensor 2.

Fig. 3B indicates that there is virtually no reduction in temperature across the assembly as far away from the surface 6 as the outer edge of the first housing 20, and even then there is only a slight reduction until the outer edge of the second housing 22 is reached.

It will be appreciated that the rectangular section of the sensor 2 shown in the Figures is only schematic, and that the sensor will in practice be of any desirable shape. The enclosing housing or housings and insulating layers will then be shaped accordingly, so as completely to enclose that part of the sensor that is not exposed to the body whose temperature is to be measured.

The assembly 30 shown in Fig. 4 comprises a thermally resistive element 32 disposed within an aluminium housing 34 of wall thickness 0.2mm to 0.3mm. Two electrical conductors 36 are soldered to respective ends of the element 32 and pass outwards through apertures in respective raised portions 38 of the housing 34, being electrically insulated where necessary. The enclosure within the housing 34 is filled with a silicon rubber compound and the element 32 is positioned for mechanical rigidity over a flat portion 40 of

the housing 34 between the raised portions 38. In this way, the element 32 is securely mounted within the housing 34 and electrically insulated therefrom. A strip of PTFE tape 42 is placed across the opening of the housing 34 so as to insulate the front face 44 of the element 32 from the body whose temperature is to be measured. The housing 34 is covered with a layer 46 of thermally insulating material.

As shown in Fig. 4, the assembly 30 is mounted on a pipe 48 of circular cross section, and through which a fluid, for example water, is arranged to pass. To this end, a flange 50 of the housing 34 extending away from and around the element 32, and the outer insulating layer 46, are shaped to conform to the outer surface of the pipe 48. The interface between the assembly 30 and the pipe 48 is smeared with a heat conducting grease so as to exclude air pockets therefrom. The assembly is secured to the pipe in any suitable manner.

It will be appreciated that a thermal sensor mounted in an assembly in accordance with the present invention is enclosed by one, or two or even more, metal or metallic housings. Thus heat from the body whose temperature is to be measured is conducted completely around the sensor, which can, therefore, more accurately represent the temperature of the body. Furthermore, since the temperature of the whole of the sensor is maintained substantially at that of the body, a thick outer block of thermally insulating material is no longer required. This is indicated by comparison in Fig. 1A, on the one hand, and in Figs. 2A and 3A, on the other hand, of the extent of the assembly in a direction perpendicular to the surface 6.

CLAIMS

1. A temperature sensing assembly for attachment to a body whose temperature is to be measured, which assembly comprises a temperature sensor enclosed in a housing of a good thermal conductor in such a way that, when the assembly is attached to the body whose temperature is to be measured, a portion of the sensor and a part of the housing are exposed to the body.

2. An assembly as claimed in claim 1, wherein the housing is enclosed, except at said portion of the temperature sensor, in thermally-insulating material to reduce heat loss therefrom.

3. An assembly as claimed in claim 2, wherein a second thermally-conductive housing extends around the thermally-insulating housing and has a part which is exposed to the body, whose temperature is to be measured; when the assembly is secured thereto.

4. An assembly as claimed in claim 3, wherein the second thermally-conductive housing is enclosed, except at said portion of

the temperature sensor, in a further thermally-insulating material.

5. An assembly as claimed in any preceding claim, wherein the or each thermally-conductive housing is made of a metal.

6. An assembly as claimed in any preceding claim, wherein the temperature sensor is an electrical resistance thermometer or a thermocouple.

- 10 7. An assembly as claimed in any preceding claim, wherein the or each thermally conductive housing is shaped to conform to the outer surface of the body whose temperature is to be measured, thereby providing good
15 thermal contact between the sensor and the body when the assembly is attached thereto.

8. An assembly as claimed in any preceding claim, wherein a layer of electrically insulating material is interposed between said portion of the temperature sensor and the body,
20 whose temperature is to be measured, when the assembly is attached thereto.

9. An assembly as claimed in any preceding claim, including a layer of heat conducting
25 grease which, when the assembly is attached to a body whose temperature is to be measured, lies intermediate the assembly and the body, whereby any undesirable air pockets are excluded from therebetween.

- 30 10. A temperature sensing assembly substantially as hereinbefore described with reference to the accompanying drawings.

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